

# Expand Networks, Inc.

## ACCELERATOR 4000

### Enterprise Caching Performance Evaluation

## Test Summary

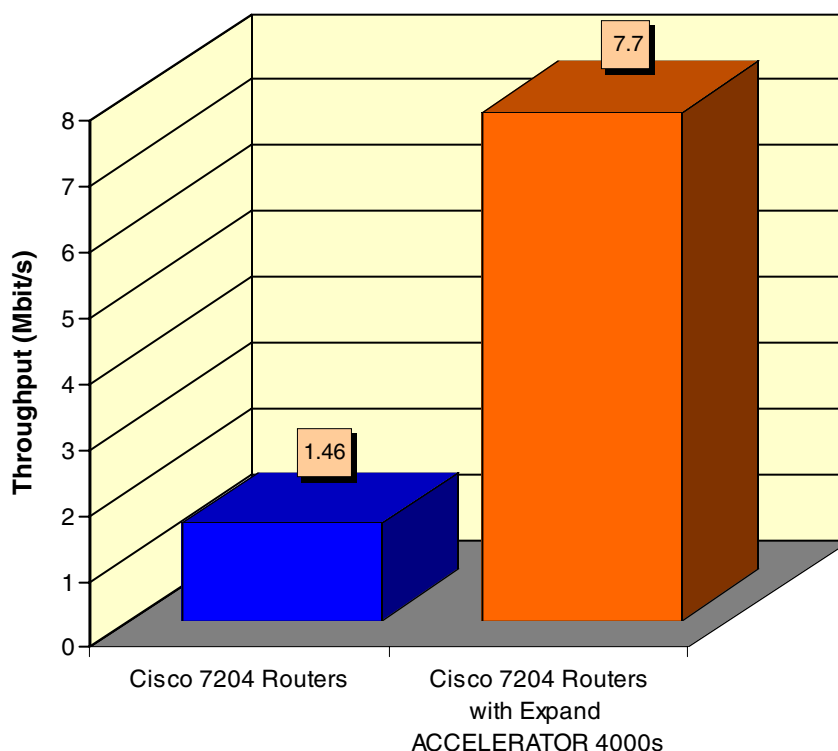
**Premise:** Network designers employing WAN links between branch-to-branch and branch-to-central offices that require high-speed connectivity are faced with two options to increase the effective data throughput of the connection. Companies may add more capacity either by ordering another circuit to complement an installed link, or by purchasing a higher-capacity WAN connection. An alternative approach is to deploy bandwidth optimization technologies such as compression and caching solutions within the respective offices on the WAN side of the router before the WAN interface to squeeze more out of existing pipes. The latter option, if proven effective, avoids the hassle of potential installation/upgrade delays, contract terms, and redeployment limitations commonly associated with leased-line options.

Expand Networks, Inc. commissioned The Tolly Group to benchmark the effective data throughput between a pair of Cisco Systems, Inc. 7204 Series routers and the caching and compression provided by Expand's ACCELERATOR 4000. Expand calls this network performance technology "Enterprise Caching" and describes it as a blend of caching techniques and adaptive packet compression to boost throughput. Engineers measured throughput across a T1 link, as well as a 256 Kbit/s link, with a pair of ACCELERATOR 4000s inserted on each end of a simulated branch-to-central office network.

### Test Highlights

- Delivers unidirectional data throughput over a T1 link of 7.7 Mbit/s with Enterprise Caching
- Enables a 256 Kbit/s link to carry 6.3 Mbit/s of effective throughput
- Provides a 5:1 acceleration ratio when transferring traffic over a T1 connection and 25:1 acceleration ratio over a 256 Kbit/s link

### Effective T1 Throughput: ACCELERATOR 4000s Enterprise Caching Unidirectional Data Flow



Source: The Tolly Group, March 2000

Figure 1

Testing was performed in November 1999.

Test results show that the ACCELERATOR 4000s with Enterprise Caching dramatically improved effective throughput. A baseline measurement of the Cisco 7204 Series routers delivered 1.46 Mbit/s over a T1 link. By contrast, effective throughput soared to 7.7 Mbit/s when the ACCELERATOR 4000s were in place.

In similar tests using a 256 Kbit/s link, the ACCELERATOR 4000s offered similar performance of 6,273 Kbit/s compared to 245 Kbit/s of effective throughput in baseline tests with the Cisco 7204 Series routers alone.

## RESULTS

### EFFECTIVE HTTP DATA THROUGHPUT OVER A T1 LINK

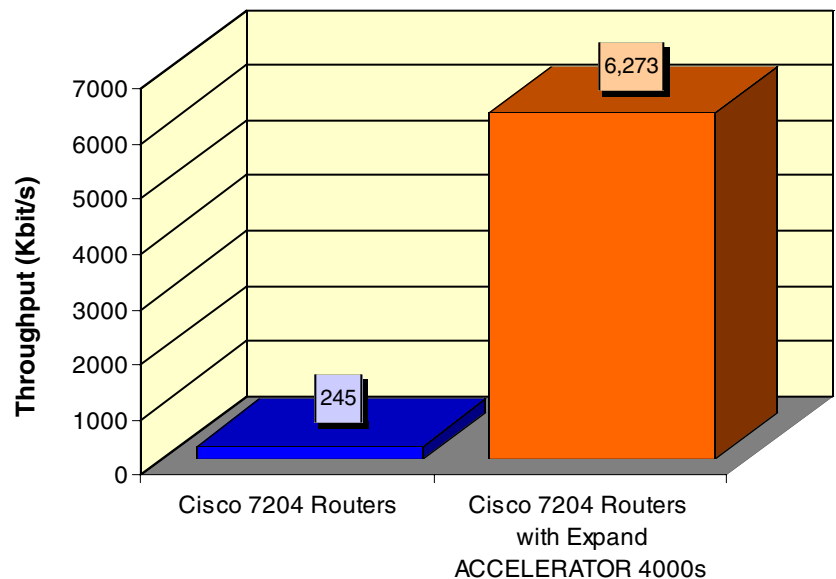
In a branch-to-central office configuration over a T1 link, effective baseline performance test results demonstrate that the Cisco 7204 Series routers delivered 1.46 Mbit/s of unidirectional data throughput in tests. By comparison, the Expand ACCELERATOR 4000s increased the effective throughput more than five-fold to 7.7 Mbit/s. — a 5:1 acceleration ratio to the theoretical maximum. See figure 1.

### EFFECTIVE DATA THROUGHPUT OVER A 256 KBIT/S LINK

In a similar set of tests using a 256 Kbit/s WAN link transferring HTTP traffic, the ACCELERATOR 4000s effective throughput was 6,273 Kbit/s, compared to the 245 Kbit/s of effective throughput of the Cisco 7204 Series routers baseline. See figure 2.

## ANALYSIS

### Effective Throughput ACCELERATOR 4000s Enterprise Caching over a 256 Kbit/s Link: Unidirectional Data Flow



Source: The Tolly Group, March 2000

Figure 2

In tests across a 256 Kbit/s WAN, throughput increased when the traffic traversing a 256 Kbit/s link was cached and compressed by the ACCELERATOR 4000s, (unidirectional downstream) to 6,273 Kbit/s from the baseline of 245 Kbit/s, which represents an accelerated ratio of 25:1 using Enterprise Caching. The same tests were run utilizing a T1 (1.544 Mbit/s) link and again only HTTP content was used (see Test Configuration & Methodology section for explanation of the HTTP content). As expected, the effective throughput increased markedly to a maximum of 7.7 Mbit/s (unidirectional downstream), which represents an accelerated ratio of 5:1 using Enterprise Caching, meaning the equivalent of five T1s of throughput can flow across a single physical T1. The serial interface on the Cisco 7204 Series routers is limited to a maximum rate of 8.2 Mbit/s (the equivalent of four E1 links at 2.048 Mbit/s each); but with the ACCELERATOR 4000s Enterprise Caching, it delivered an effective accelerated ratio of 6,273 Kbit/s. While the relative benefit of Enterprise Caching for

a T1 link based on the 8 Mbit/s output limitation of the router is not as great as that for the 256 Kbit/s link, the equivalent of five T1 links represents a significant economic benefit to users needing to upgrade their existing T1 links.

## TEST CONFIGURATION AND METHODOLOGY

The test bed consisted of two Expand Networks, Inc. ACCELERATOR 4000 version 1.2.2 Enterprise Caching devices, each linked via either a T1 or 256 Kbit/s connection to a Cisco Systems, Inc. Cisco 7000 Series Router, model 7204 version 12.0 (7) Enterprise Edition. Not all products were used in all tests. There was no configuration for the ACCELERATOR 4000s since the devices are autosensing and only require a user to physically connect devices for operation. The Cisco 7204s were configured for external clocking, meaning that the Cisco 7204s took their clocking feed from the external ACCELERATOR 4000s, which set a maximum serial port

speed of 8 Mbit/s. Each Cisco 7204 was connected to two Performance Technologies, Inc. Nebula 4000 Workgroup Switch, both version 5.3.1 10/100 Mbit/s Fast Ethernet switches. The ports connected to the Cisco 7204s were configured for half-duplex Ethernet because the routers only support half-duplex Ethernet. The Nebula switches connected the Cisco 7204s to the Web servers and clients, which linked to the Nebula switches via full-duplex Ethernet connections.

Flow Control, Spanning Tree and all other ancillary functions were disabled on the switching devices to eliminate the possibility that those functions would adversely affect performance. Each of the Cisco 7204 routers was also connected to a VIR Systems MOD-35 Line Simulator to provide external clocking in the absence of the ACCELERATOR 4000s.

Microsoft Corp. Windows NT Server version 4.0 SP5 Enterprise Edition operating system ran on two 450-MHz Compaq ProLiant 550 Intel Pentium IIs positioned as Web servers. Each of these devices was outfitted with 256 Mbytes of RAM and 4 Gbytes of fixed disk space. The Web servers also were running Microsoft Internet Information Server IIS version 3.0. Two Compaq Netelligent 10/100 Mbit/s PCI network adapters, model NC3123, were installed on the servers, both of which were connected to one of the Cisco 7204 routers via the Nebula switches.

The other Cisco 7204 router connected four clients (all running Microsoft Windows NT Workstation version 4.0 SP5 and Ziff-Davis Inc.'s WebBench Client version 3.0) to a Ethernet switch on one end and an ACCELERATOR 4000 on the other.

A WebBench Controller version 3.0 running Microsoft Windows NT Workstation version 4.0 controlled the clients. The WebBench Con-

troller ran on a 200-MHz Intel Pentium IBM PC clone with 32 Mbytes of RAM and 2 Gbytes of fixed disk space. An IBM 100 Mbit/s EtherJet PCI network adapter was installed on the controller.

The four clients were also running Internet Explorer version 4.0: A 200-MHz Intel Pentium IBM PC clone with 32 Mbytes of RAM and 2 Gbytes of fixed disk space and an IBM EtherJet PCI network adapter installed; a 200-MHz Intel Pentium IBM PC clone with 32 Mbytes of RAM and 2 Gbytes of fixed disk space and a 3Com Corp. Etherlink 3C595 100 Mbit/s PCI network adapter installed; a 200-MHz Intel Pentium IBM PC clone with 32 Mbytes of RAM with 2 Gbytes of fixed disk space with a Compaq Netelligent 100 Mbit/s PCI network adapter installed; and a 200-MHz Intel Pentium IBM PC clone with 32 Mbytes of RAM and 2 Gbytes of fixed disk space with a Compaq Netelligent 100 Mbit/s PCI network adapter installed.

Engineers configured Wavetek Wandel Goltermann Domino Core Software version 2.4 on a 200-MHz Intel Pentium IBM PC clone with 32 Mbytes of RAM and 2 Gbytes of fixed disk space. The controller was running Microsoft Windows NT Workstation 4.0 SP5.

The HTTP data source consisted of 30 HTML files ranging in size from 5 Kbytes to 203 Kbytes and each client was configured to receive each page from one to as many as 30 times for the duration of the test. In order to create HTML content for the tests, The Tolly Group visited the top 30 most-traveled Web sites — excluding CBS Sports and MSNBC sites. Engineers downloaded the home pages, and all associated graphics, of the top 30 sites; all associated images were concatenated to create a single Web object in HTML format for each Web site visited. The resulting files were used as

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**ACCELE-  
TOR 4000**

**Enterprise  
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**Expand Networks, Inc.  
ACCELERATOR 4000  
Product Specifications\***

#### **Enterprise Caching**

- Selectively caches data that is frequently used on the link, such as images, JavaScript and other blocks of data in other protocols
- Maintains mirrored caches in each node
- Takes two similar packets, caches the common pieces and forwards the unique differences

#### **Vertical Data Analysis**

- Automatically divides the packet into its various layers, reducing the size of "header style" information to virtually nothing and transfers all the rest to the caching and compression algorithms for further processing

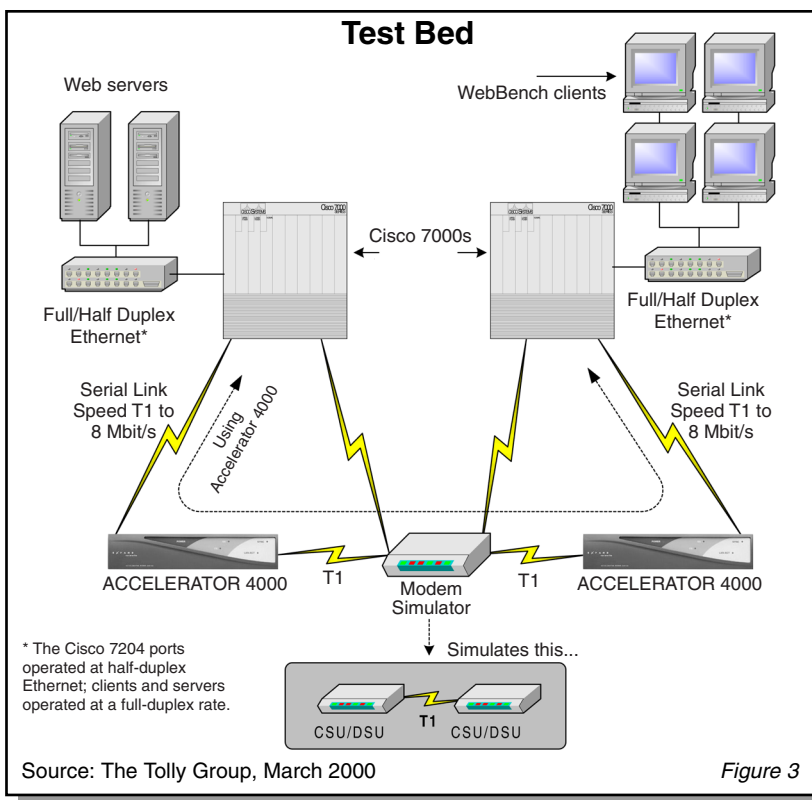
#### **Adaptive Packet Compression**

- Applies an adaptive algorithm to information that is not cached and is not part of headers. Various types of information like HTML, JavaScript, Citrix ICA, SQL, etc. are each treated using an adapting algorithm that gets optimized to handle this specific type of data

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*\*Vendor-supplied information not verified  
by The Tolly Group*



the basis of a custom WebBench workload. Client workstations were configured to request these pages as quickly as they could for the duration of the test.

For baseline throughput tests of the Cisco 7204 Series routers, engineers configured the routers so that STAC compression was disabled. WAN serial interfaces were configured to take their clocking externally. Engineers configured the appropriate WebBench custom-generated script for a duration of five minutes. Tests were repeated three times and the results averaged. Engineers followed the same procedure during tests of the Cisco 7204s with the ACCELERATOR 4000s enabled.

**The Tolly Group gratefully acknowledges the providers of test equipment used in this project.**

**Vendor**

Wavetek Wandel Goltermann  
Ziff-Davis Inc.

**Product**

Domino Core Software  
WebBench

**Web address**

<http://www.wg.com>  
<http://www.zd.com>



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## PROJECT PROFILE

**Sponsor:** Expand Networks, Inc.

**Document number:** 200214

**Product class:** Enterprise Caching device/throughput accelerator

**Products under test:**

- ACCELERATOR 4000 version 1.2.2

**Testing window:** November 1999

**Software status:**

- Generally available

**Additional information available:**

- Technical Support Diary
- Configuration Files

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